



Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

Elsevier hereby grants permission to make all its COVID-19-related research that is available on the COVID-19 resource centre - including this research content - immediately available in PubMed Central and other publicly funded repositories, such as the WHO COVID database with rights for unrestricted research re-use and analyses in any form or by any means with acknowledgement of the original source. These permissions are granted for free by Elsevier for as long as the COVID-19 resource centre remains active.



# Public Health in Emergency Medicine

## CLINICAL FEATURES OF PATIENTS WITH COVID-19: IS TEMPERATURE SCREENING USEFUL?

Gary M. Vilke, MD, Jesse J. Brennan, MA, Alexandra O. Cronin, MPH, and Edward M. Castillo, PHD, MPH

Department of Emergency Medicine, University of California San Diego, San Diego, California

Corresponding Address: Alexandra O. Cronin, MPH, Department of Emergency Medicine, 200 W Arbor Dr, Mailcode #8676, San Diego, CA 92103

**Abstract—Background:** As many businesses reopen after government-induced restrictions, many public agencies and private companies, such as banks, golf courses, and stores, are using temperature screening to assess for possible coronavirus disease 2019 (COVID-19) infection both for patrons and for employees. **Objective:** We assessed the frequency of a fever  $\geq 100.4^{\circ}\text{F}$  and other symptoms associated with COVID-19 among patients in the emergency department (ED) who were tested in the ED for the illness. **Methods:** This is a retrospective review of data from patients who were tested for acute COVID-19 infection from March 10, 2020 through June 30, 2020 at two EDs within the same health care system. Data collected included temperature, the presence or recent history of COVID-19–related symptoms, and COVID-19 test results. Descriptive statistics are reported for presenting fever and other COVID-19–related symptoms alone and in combination with presenting fever. **Results:** A total of 6894 patients were tested for COVID-19. Among these, 330 (4.8%) tested positive for active infection. Of these patients, 64 (19.4%) presented with a fever  $\geq 100.4^{\circ}\text{F}$  ( $\geq 38.0^{\circ}\text{C}$ ). Increasing the number of COVID-19–related symptoms in combination with a presenting fever  $\geq 100.4^{\circ}\text{F}$  increased the number of people who could be identified as having a COVID-19 infection. **Conclusions:** About a quarter of patients who were tested positive for COVID-19 in our ED did not have a fever at presentation  $\geq 100.4^{\circ}\text{F}$ . Using only temperature to screen for COVID-19 in the community setting will likely miss the majority of pa-

tients with active disease. © 2020 Elsevier Inc. All rights reserved.

**Keywords—COVID-19; ED utilization; pandemic**

### INTRODUCTION

The novel coronavirus disease 2019 (COVID-19) pandemic has caused challenges in both medical and economic communities worldwide. While many medical systems dealt with an exponential increase in census that left them short on resources to safely manage patients and protect health care providers, other systems planned for a surge of COVID-19 patients that never came, potentially because of the government-issued stay-at-home order, social distancing, nonessential business closures, and public gathering restrictions to reduce the spread of the virus and “flatten the curve.” As businesses such as banks, golf courses, and restaurants reopen, many are using temperature screening as the primary way to assess patrons and employees for possible COVID-19 infection.

Although elevated temperature is not specific to having a COVID-19 infection, it has been considered a main clinical finding of the viral infection among other symptoms at initial presentation (1–3). However, a fever is consistent with other potentially contagious illnesses for which avoiding public places is also beneficial to others. Many medical facilities are using temperature in addition to wellness questionnaires to

Reprints are not available from the authors.

RECEIVED: 8 July 2020; FINAL SUBMISSION RECEIVED: 21 August 2020;  
ACCEPTED: 12 September 2020

screen patients and staff (4,5). The question that remains, however, is whether elevated body temperature is an appropriate indicator of active COVID-19 infection or if it should be used in combination with other clinical factors or history. Is elevated body temperature screening giving the community a false sense of security, or is there a shown benefit? The U.S. Centers for Disease Control and Prevention (CDC) recommends checking temperatures of manufacturing workers and employers at the start of each shift to identify anyone with a fever  $\geq 100.4^{\circ}\text{F}$  ( $\geq 38.0^{\circ}\text{C}$ ) or reported feelings of feverishness. The CDC further recommends not allowing employees to enter the workplace if they have a fever  $\geq 100.4^{\circ}\text{F}$  (6). The CDC website offers no references to which these recommendations were based.

The purpose of this study is to assess the frequency of a fever  $\geq 100.4^{\circ}\text{F}$  and other symptoms associated with COVID-19 among patients tested for the illness when they present to the emergency department.

## MATERIALS AND METHODS

### *Design and Setting*

This is a retrospective review of data from all patients who were tested for acute COVID-19 infection from March 10, 2020 through June 30, 2020 at two EDs within the same health system with a shared electronic medical record (EMR). One hospital is an urban-based academic quaternary medical center with a Level 1 trauma center. The other is a community-based hospital with an accredited geriatric ED. The combined annual census is approximately 85,000 patients. This study was approved by the institution's Human Research Protections Program.

### *Participants and Data Collection*

All patients presenting to the ED who were tested for acute COVID-19 infection while in the ED or within two hours of their triage temperature (if they were admitted and tested after they left the ED) were included in the study population. Data collected from the EMR using standard queries included clinical characteristics including initial temperature, the presence or recent history of COVID-19–related symptoms, and COVID-19 test results.

The health system used two diagnostic tests during the study period to assess for SARS-CoV-2, the Abbot ID Now COVID-19 assay, and the ePlex SARS-CoV-2. The Abbot ID Now assay is a rapid test that detects the presence of virus RNA from direct nasal, nasopharyngeal, or throat swabs. The ePlex SARS-CoV-2 test detects virus particles in clinical samples collected with a

nasopharyngeal swab and was conducted under the GenMark Diagnostics platform. Both tests were conducted in-house at our institution's clinical laboratory under U.S. Food and Drug Administration Emergency-Use Authorization (EUA).

### *Data Analysis*

Fever was defined as a temperature  $\geq 100.4^{\circ}\text{F}$ . Symptoms were identified from presenting complaints and provider notes. Body aches included body aches, myalgia, or muscle pain. Shortness of breath included shortness of breath, difficulty breathing, or respiratory distress. Fatigue included fatigue, weakness, malaise, or lethargy. Sinus problem included congestion, rhinorrhea, or runny nose. Sore throat included sore throat or pharyngitis. The remaining symptoms are reported as collected. Descriptive statistics are reported for presenting fever and other COVID-19–related symptoms alone and in combination with presenting fever by test result. All analyses were conducted with SPSS software (version 25.0; IBM Corp, Inc, Armonk, NY).

## RESULTS

Overall, 20,061 ED encounters took place between March 10, 2020 and June 30, 2020, of which a total of 6894 patients were tested for COVID-19 infection. Among those tested, 330 (4.8%) tested positive for active infection. Of the 6564 (95.2%) patients who tested negative for COVID-19, 368 (5.6%) presented with a fever  $\geq 100.4^{\circ}\text{F}$  ( $\geq 38.0^{\circ}\text{C}$ ). Of the 330 patients that tested positive for COVID-19, 64 (19.4%) presented with a fever  $\geq 100.4^{\circ}\text{F}$ . COVID-19–related symptoms were seen in a lower percentage of patients who tested negative. A descriptive summary of COVID-19–related symptoms is presented in [Table 1](#).

A fever  $\geq 100.4^{\circ}\text{F}$  was also queried in combination with the other symptoms that increased the number of people who could be identified as having an active COVID-19 infection. However, having combined symptoms is not specific to COVID-19 infection. Similarly, the number of patients who tested negative for active COVID-19 infection also increased when combining symptoms, though the percentage was lower. Patients presenting with a fever  $\geq 100.4^{\circ}\text{F}$  and with additional symptoms included by COVID-19 test results are presented in [Table 2](#).

## DISCUSSION

Our results show that only about one-fifth of patients who were diagnosed with COVID-19 in the ED presented with the recommended CDC cutoff of a fever

**Table 1. COVID-19–Related Symptoms by COVID-19 Test Results for Patients in the Emergency Department, March 10, 2020 through June 30, 2020**

Symptom, n (%)	COVID-19 Detected (n = 330)	COVID-19 Not Detected (n = 6564)
Presenting fever	64 (19.4)	368 (5.6)
Cough	213 (64.5)	1748 (26.6)
Recent fever or chills	193 (58.5)	1608 (24.5)
Shortness of breath	154 (46.7)	1890 (28.8)
Fatigue	65 (19.7)	1254 (19.1)
Body aches	59 (17.9)	420 (6.4)
Nausea or vomiting	52 (15.8)	1108 (16.9)
Sore throat	40 (12.1)	438 (6.7)
Loss or change in taste or smell	38 (11.5)	109 (1.7)
Diarrhea	34 (10.3)	558 (8.5)
Sinus problem	31 (9.4)	266 (4.1)
Headache	27 (8.2)	434 (6.6)

COVID-19 = coronavirus disease 2019.

$\geq 100.4^{\circ}\text{F}$ , which was the sixth most common symptom. A combination of active fever and additional COVID-19–related symptoms identified  $>80\%$  of active COVID-19 cases. Based on the findings in our study, for places of business, such as banks and golf courses, that are only using or considering using body temperature screening as an indication of COVID-19 infection, four of five individuals with active COVID-19 could potentially be missed. In other words, we found that fever alone is an inconclusive measure of symptom-based screening for COVID-19 infection. Additional analyses specific to other patient populations and health systems are necessary to further validate these results. Nonetheless, it may be more beneficial for businesses to consider adopting a combination of both fever and symptom-based screening measures to further limit the spread of COVID-19.

These results are similar to those of other studies looking at different populations of patients. Qui et al. reported that common symptoms for 36 children 0–16 years of age were fever (13 [36%]) and dry cough (7 [19%]). Of those with fever, four (11%) had a body temperature  $\geq 38.5^{\circ}\text{C}$  and nine (25%) had a body temperature of  $37.5\text{--}38.5^{\circ}\text{C}$  (7). Liu et al. reported 78 patients with COVID-19–associated pneumonia. They assessed patients who presented

with fever and either progressed to become clinically worse or improved and stabilized. They found that the maximum body temperature at admission was significantly higher in the progression group than in the improvement/stabilization group ( $38.2^{\circ}\text{C}$  vs.  $37.5^{\circ}\text{C}$ ) (8). They did not report the percentage of patients who presented with a fever.

Tolia et al. reported on 283 tests ordered in the ED setting, of which most patients did not have a fever and only 10.2% tested positive for COVID-19 (9). Of the 29 patients with positive test results, only two patients (6.9%) were reported to have presented with a fever. Quilty et al. evaluated the effectiveness of thermal passenger screening for COVID-19 infection at airport exit and entry to inform public health decision making (10). For the baseline scenario, they estimated that 44 of 100 infected travelers would be detected by exit screening and that none of the cases would develop severe symptoms during travel, nine additional cases would be detected by entry screening, and the remaining 46 would not be detected. They concluded that because of the duration of the incubation period of COVID-19 infection, exit or entry screening at airports for initial symptoms via thermal scanners is unlikely to prevent passage of infected travelers into new countries.

**Table 2. Patients Presenting with a Fever  $\geq 100.4^{\circ}\text{F}$  and with Additional Symptoms Included by COVID-19 Test Result, March 10, 2020 through June 30, 2020**

Symptoms, n (%)	COVID-19 Detected (n = 330)	COVID-19 Not Detected (n = 6564)
Presenting with fever	64 (19.4)	368 (5.6)
Presenting with fever or recent fever/ chills	203 (61.5)	1679 (25.6)
Cough or any of above	266 (80.6)	2680 (40.8)
Shortness of breath or any of above	274 (83.0)	3430 (52.3)
Fatigue or any of above	280 (84.8)	4001 (61.0)
Body aches or any of above	282 (85.5)	4045 (61.6)

COVID-19 = coronavirus disease 2019.

Overall, it appears that routine temperature screening alone will pick up a small minority of positive COVID-19 patients in the community setting at nonmedical locations. Adding recent COVID-19 symptoms to the screening process will improve sensitivity, but it appears that CDC-recommended screening for manufacturing workers using fever alone will miss many possibly positive cases of COVID-19. This is better than no screening process, but the public should not have a false sense of safety and security by use of the temperature only screening technique. In addition, continued, stringent use of appropriate personal protective equipment and handwashing along with social distancing when appropriate is still necessary.

### Limitations

Limitations of the study include the retrospective nature of the data. There could be patients who had COVID-19 screening symptoms that were not documented in the medical chart or that were missed in the review of records. Although 100.4°F is often used as the temperature threshold, numerous other thresholds are being used for temperature screening. However, although using a threshold of 100°F in our population only increased fever at presentation to 24.8%, using the lower threshold did not impact the proportions when combined with other COVID-19-related symptoms. This study also summarizes patient populations at two hospitals within a single health system that may differ from other patient populations. Finally, in our query we did not include whether patients had been administered antipyretics before or during their ED visit.

### CONCLUSIONS

We conclude that most patients who tested positive for COVID-19 in our ED did not have a fever of  $\geq 100.4^\circ\text{F}$

at presentation. Using temperature only to screen for COVID-19 will likely miss most patients with active disease and should be used in combination with additional symptom screening. The presence of symptoms will also likely change during the influenza season and should be reassessed at that time.

*Acknowledgments*—Gary M. Vilke, MD, is a paid legal consultant.

### REFERENCES

1. Li LQ, Huang T, Wang YQ, et al. COVID-19 patients' clinical characteristics, discharge rate, and fatality rate of meta-analysis. *J Med Virol* 2020;92:577–83.
2. Tian S, Hu N, Lou J, et al. Characteristics of COVID-19 infection in Beijing. *J Infect* 2020;80:401–6.
3. Zhu J, Ji P, Pang J, et al. Clinical characteristics of 3,062 COVID-19 patients: a meta-analysis. *J Med Virol* 2020. [Epub ahead of print].
4. Wang Q, Wang X, Lin H. The role of triage in the prevention and control of COVID-19. *Infect Control Hosp Epidemiol* 2020. [Epub ahead of print].
5. Rasmussen SA, Jamieson DJ. Coronavirus disease 2019 (COVID-19) and pregnancy: responding to a rapidly evolving situation. *Obstet Gynecol* 2020;135:999–1002.
6. U.S. Centers for Disease Control and Prevention website. Manufacturing workers and employers. Available at: [www.cdc.gov/coronavirus/2019-ncov/community/guidance-manufacturing-workers-employers.html](http://www.cdc.gov/coronavirus/2019-ncov/community/guidance-manufacturing-workers-employers.html). Accessed July 8, 2020.
7. Qiu H, Wu J, Hong L, Luo Y, Song Q, Chen D. Clinical and epidemiological features of 36 children with coronavirus disease 2019 (COVID-19) in Zhejiang, China: an observational cohort study. *Lancet Infect Dis* 2020;20:689–96.
8. Liu W, Tao ZW, Wang L, et al. Analysis of factors associated with disease outcomes in hospitalized patients with 2019 novel coronavirus disease. *Chin Med J (Engl)* 2020;133:1032–8.
9. Tolia VM, Chan TC, Castillo EM. Preliminary results of initial testing for coronavirus (COVID-19) in the emergency department. *West J Emerg Med* 2020;21:503–6.
10. Quilty BJ, Clifford S, Flasche S, Eggo RM, CMMID nCoV working group. Effectiveness of airport screening at detecting travellers infected with novel coronavirus (2019-nCoV). *Euro Surveill* 2020;25:2000080. Erratum in *Euro Surveill* 2020;25:2002132.

## ARTICLE SUMMARY

### **1. Why is this topic important?**

Communities that have reopened or that have considered reopening need more accurate measures than fever alone to screen individuals for coronavirus disease 2019 (COVID-19) infection to prevent the spread of the virus.

### **2. What does this study attempt show?**

Our study shows the need for more accurate and appropriate symptom-based screening measures to be used to guide the economic reopening of communities amid the COVID-19 pandemic. It also shows that fever alone is not a sufficient marker of COVID-19 infection and thus should not be the sole metric used for screening infected patients in communities.

### **3. What are the key findings?**

We found that fever is not present in all cases of COVID-19. In fact, there are inconsistencies in the reported and observed symptoms of COVID-19, none of which have proven to be an effective screening measure for detecting viral infection.

### **4. How is patient care impacted?**

Allowing for premature reopening without safe, accurate guidelines to prevent additional COVID-19 cases presents the risk of creating a false sense of security in communities. This false sense of security creates a degree of risk in spreading the virus that can further impact the health system unnecessarily and reduce the ability to care for COVID-19 patients and other patients in need of health care resources.